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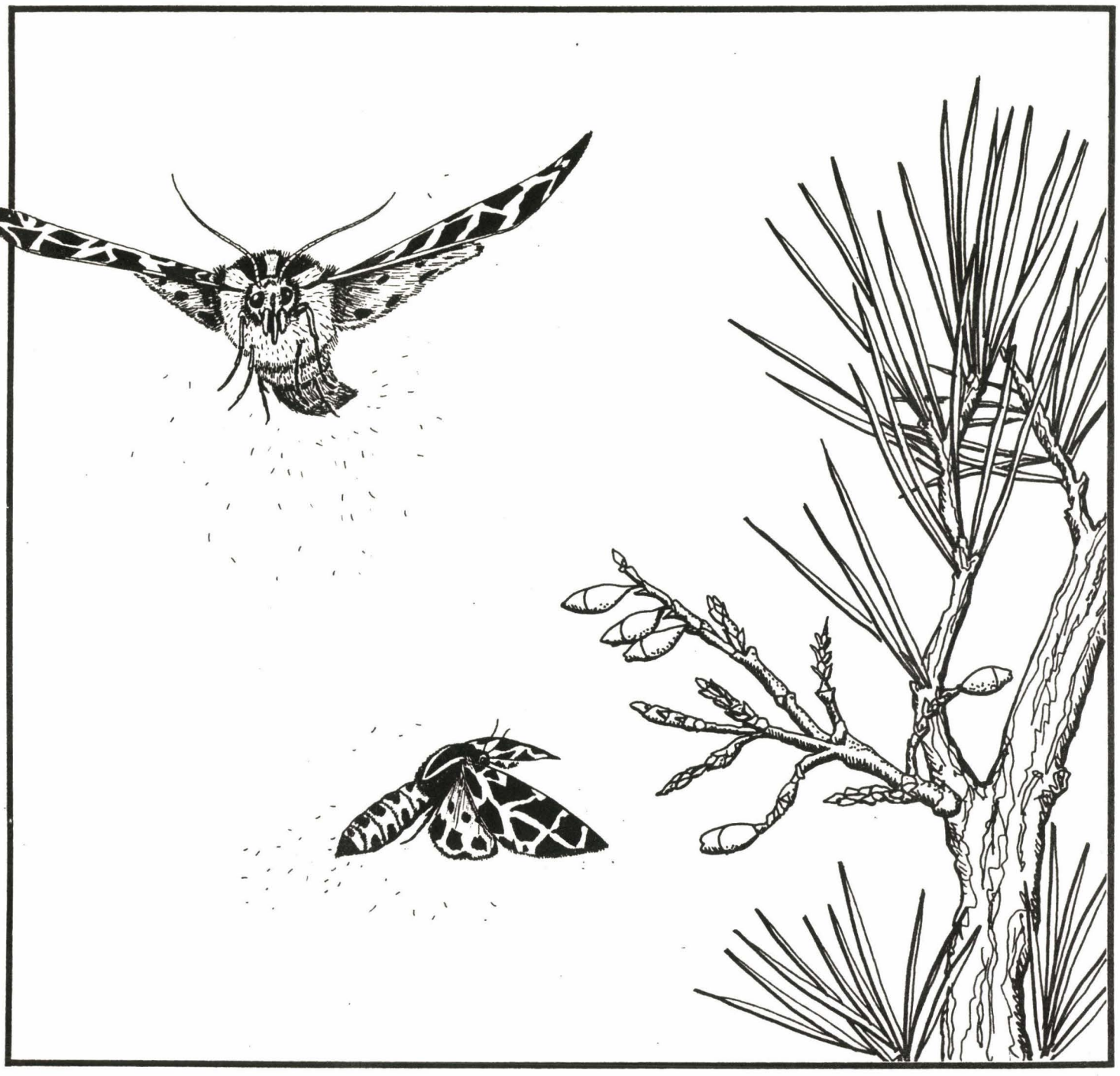
Timber,
Forest Pest,
& Cooperative
Forestry
Management

Denver, Colorado

FOREST PEST CONDITIONS IN THE ROCKY MOUNTAIN REGION FOR 1988



FOREST PEST CONDITIONS

IN THE

ROCKY MOUNTAIN REGION

1988

By

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June 1989

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TABLE OF CONTENTS

	PAGE
Table of Contents	i
Mailing List Update and Revision	ii
Acknowledgements	iii
Management Staff Organizational Chart	iv
Introduction	1
Forest Pest Management Service Centers	1
Forest Pest Management Workshops and Training	3
Insect and Disease Conditions in Brief	3
Douglas-fir Cover Type	4
Ponderosa Pine Cover Type	5
Lodgepole Pine Cover Type	8
Aspen Cover Type	13
Urban and Shelterbelt Tree Problems	15
Abiotic Diseases	18
Nursery Studies	19
Summary of Insects	20
Summary of Diseases	23
Use of Herbicides in Region 2 for 1984-1988	27
Pesticide Use in Region 2 in FY 88	28
Recent Publications	30

MAILING LIST UPDATE AND REVISION - Annual Report 1988

At this time, we wish to update our mailing list of all cooperators. Only those persons or agencies returning this form by July 31, 1989 will receive subsequent mailings of reports. Please complete this form and return to:

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- ☐ Entomology biological evaluations
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ACKNOWLEDGEMENTS

The Forest Pest Management (FPM) Staff of the Timber, Forest Pest, and Cooperative Forestry Management Unit extends appreciation to all cooperators who contributed to this report. This years cover was designed by Curtis O'Neil.

Information on specific pest problems may be obtained from the Forest Pest Management Staff Unit located in the Forest Service Regional Office in Lakewood, Colorado (Commercial 303-236-9554 or FTS 8-776-9554) or from the Gunnison Service Center (303-641-0471) or from the Rapid City Service Center (605-394-1960) as well as the following State Foresters:

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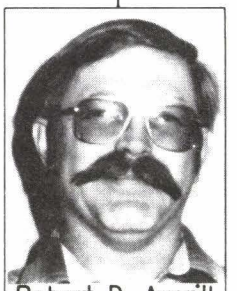

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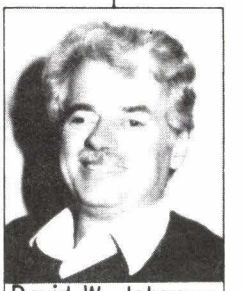

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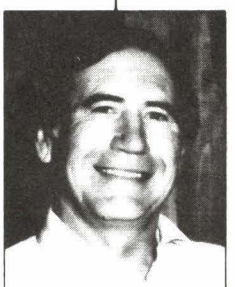

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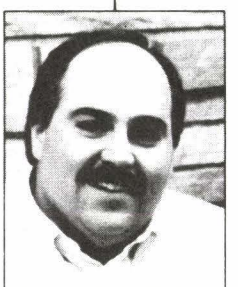

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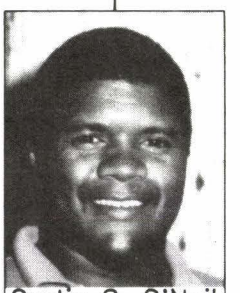

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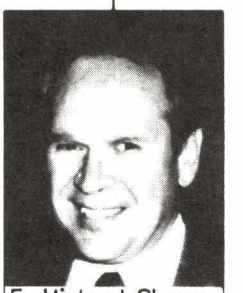

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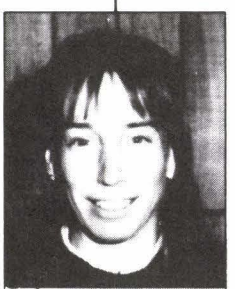

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Rocky
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Region

INTRODUCTION

Forest Pest Management (FPM) is responsible for detection, evaluation, prevention and suppression of insects and diseases on forested Federal lands. Forest Pest Management also administers financial and technical assistance programs, which are available to State and private forest landowners through the Cooperative Forestry Assistance Act of 1978, Public Law (95-313).

FOREST PEST MANAGEMENT SERVICE CENTERS

In addition to the central FPM office in Lakewood, Colorado, a Service Center was established in Gunnison, Colorado. A Rapid City, South Dakota Service Center will be operational in 1989. These offices provide service to all federal land management agencies, including the Forest Service, and coordination with State and private landowners in their area of operations. Activities will include the traditional FPM roles of planning and implementing evaluations of insect and disease pests, and advising on technical phases of forest pest management operations.

Bernie Raimo, Supervisory Entomologist and Service Center Leader, moved to Gunnison from the Regional Office where he was an entomologist for nine years. Peter Angwin, who recently completed a doctoral program at Oregon State University, serves as the Center's forest pathologist.

The Gunnison Service Center is located at 216 North Colorado with the Cebolla and Taylor River Ranger Districts, the Soil Conservation Service, and the Bureau of Land Management Area Office. The Service Center will provide assistance to cooperators west of the Continental Divide in Colorado (see Figure 1).

Judith Pasek, Supervisory Entomologist and Service Center Leader, will move from the Forestry Sciences Laboratory, Lincoln, Nebraska to Rapid City, South Dakota. Judy will be responsible for operations of the Rapid City Service Center located with the Rocky Mountain Forest and Range Experiment Station at the Forestry Sciences Lab, South Dakota School of Mines and Technology. This Service Center will provide assistance to cooperators east of the Continental Divide in northern Wyoming, all of South Dakota and Nebraska (see Figure 1).

The Service Centers were established to provide timely and effective FPM services to their customers. Questions concerning Center operations and requests for service can be directed to Charles Fudge, Director, TFP&CFM in the Regional Office or the respective Service Center Leaders.

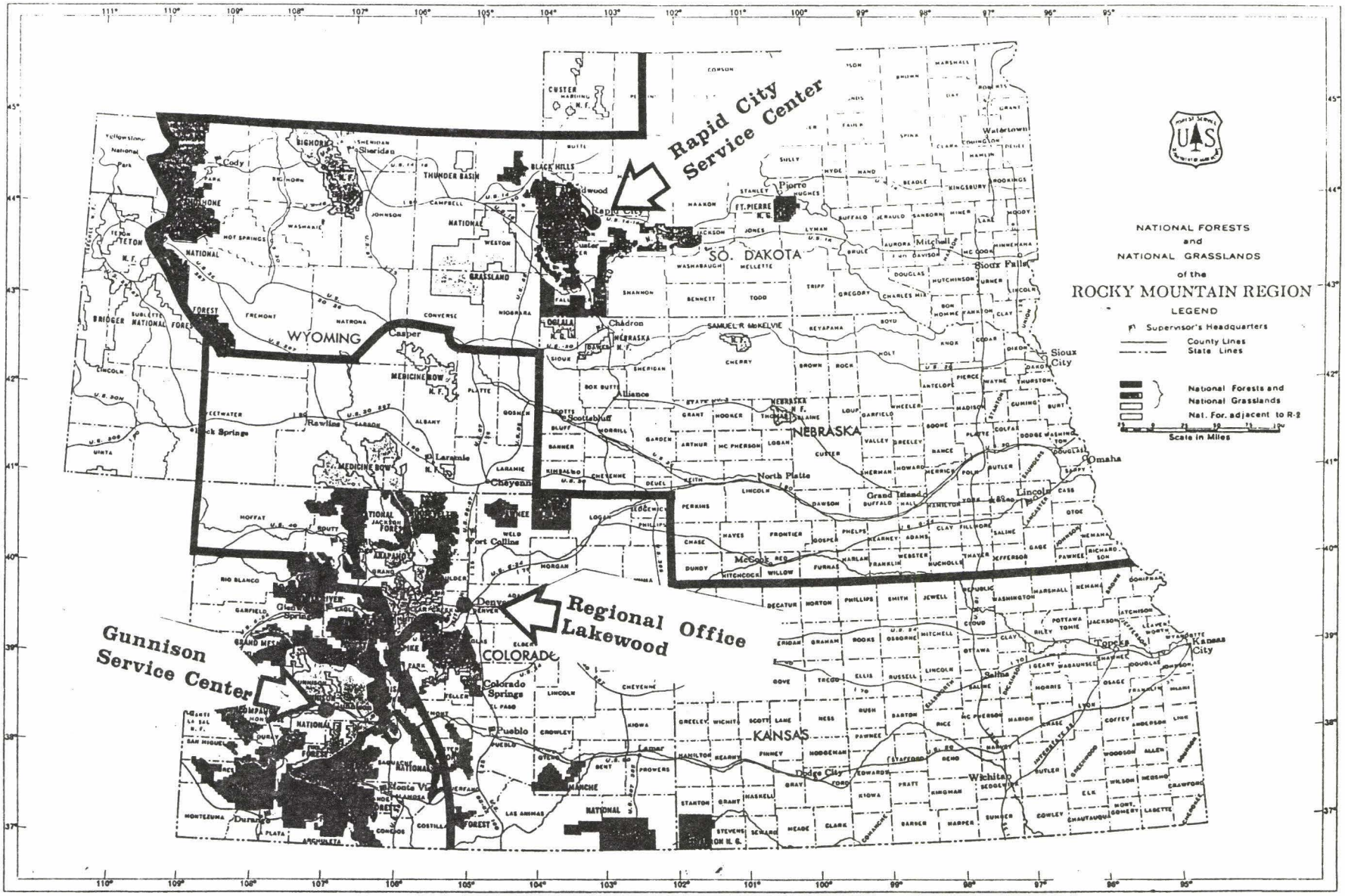

Figure 1. Forest Pest Management Service Centers.

FOREST PEST MANAGEMENT WORKSHOPS AND TRAINING

The Forest Pest Management staff group conducted several workshops during the year. A session on recognition and suppression of major forest insects and diseases in the Region was held in Frisco, Colorado (June 7-9). Twenty-seven people attended from several federal agencies and the Colorado Forest Service.

A session on evaluating trees for hazard was held in Glenwood Springs, Colorado (May 25-26). This workshop was last offered in 1982. It has been updated to address problems in the urban and community forest in addition to developed recreation areas on federal lands. Arborists, city foresters and National Forest personnel attended (14).

At the request of Forest Pest Management in Region 10, a hazard tree workshop was offered on the Chugach National Forest in Alaska in September. Twenty-six people attended from several federal agencies, private tree services and the Alaska Department of Natural Resources. The week following the workshop, principles learned for reducing risk were applied to several recreation areas on the National Forest. It was gratifying to see the immediate application of principles taught only a few days before.

A forest insect and disease presentation was also given at the request of the Evergreen Homeowners Association in June in Evergreen, Colorado.

INSECT AND DISEASE CONDITIONS IN BRIEF

Mountain pine beetle and western spruce budworm damage levels are down throughout most of the Region. Mountain pine beetle is still a major problem on the Douglas Ranger District, Medicine Bow National Forest. Plans to monitor western spruce budworm activity in response to silviculture treatments on the Pike National Forest were halted due to lack of bids for timber sales in the area. Douglas-fir beetle populations and subsequent tree mortality increased throughout much of the Colorado Front Range. Most of the current infestation started in stands of Douglas-fir hard hit by budworm in the recent past.

The gypsy moth trapping program continued throughout the Region. A single adult male moth was trapped at Eagle Creek campground on the Shoshone National Forest. This was the first gypsy moth caught on National Forest System lands in the Region. In addition, 194 moths were trapped on private land in Ft. Collins, Boulder and Lakewood, Colorado. The Colorado State Forest Service initiated eradication treatment in Boulder and Ft. Collins, Colorado. The treatment was successful in areas treated.

Aerial survey efforts were hampered by thick smoke from forest fires during the peak visibility period for tree fading and defoliation; therefore, estimates of acres affected, and graphs and tables that support them, are not included this year in the report. Forests in Wyoming and South Dakota were affected by smoke drifting from the Yellowstone Park fires.

Dwarf mistletoes continued as the most damaging disease agents in the Region. Survey and suppression activities for lodgepole pine dwarf mistletoe have continued in Colorado and Wyoming.

Forest Pest Management funded presuppression surveys on 27,432 acres on four National Forests and silvicultural control on 3,714 acres on seven National Forests.

The growth regulator ethephon has been tested in several sites on lodgepole pine and ponderosa pine dwarf mistletoes for effectiveness in reducing spread of the parasite. Continued monitoring of previous tests is planned.

Failure of a small percentage of aspen stands to regenerate successfully has resulted in a study of several sites in the Region. Continued investigation of the causes of aspen sprout failures is planned for the future.

The use of pesticides continues as an important part of integrated pest management. Pesticides are valuable tools in forest tree nursery management and control of noxious weeds and undesirable vegetation in range management. More than 18,000 acres were treated with pesticides in 1988.

The major cover types in the Region have age class distributions which are not conducive to a healthy forest. In all cases, the majority of the trees in a cover type are approaching maturity. Insects and diseases are expected to be a driving force, along with fire, in modifying the current vegetation.

DOUGLAS-FIR COVER TYPE

INSECTS AND DISEASES THAT AFFECT THE DOUGLAS-FIR COVER TYPE

Western spruce budworm: *Choristoneura occidentalis* Freeman

Western spruce budworm populations continued their overall decline in the Region. Visible defoliation on federal and private lands was at the lowest level in nearly 15 years. Observations made during bark beetle surveys indicate further reduction in visible defoliation in Wyoming and along the Colorado Front Range.

Between 11,000 and 12,000 acres of visible defoliation on the Dolores Ranger District, San Juan National Forest created public concern. An egg mass survey and evaluation were conducted. It indicated budworm population levels will be less in 1989 than that observed in 1988. Significant defoliation occurred in the area of Divide West into southern South Park, Colorado also. About 600 acres of Douglas-fir were sprayed in the Mueller Ranch State Park near Divide and Salida, Colorado.

Douglas-fir tussock moth: *Orgyia pseudotsugata* McDonnough

No significant defoliation on National Forest System lands was detected or reported in 1988. Between 1983 and 1986, several small stands of Douglas-fir were severely defoliated along the Platte River drainage, Pike National Forest. That activity prompted the establishment of 60 permanent pheromone survey plots on the Pikes Peak and South Platte Ranger Districts in 1986. This past year, a total of 240 adult male moths were lured into 300 pheromone-baited traps. The number of moths per trap per plot was comfortably below management concern and indicative of low population levels.

On private land, the Colorado State Forest Service discovered the tussock moth in Vail, Colorado. Subsequent pheromone trap surveys were marred by faulty traps or improper handling of the traps.

Traps were also placed in the Golden District communities west of Denver, but had the same problem as those in Vail. Another survey is planned for 1989.

Douglas-fir beetle: *Dendroctonus pseudotsugae* Hopkins

The Douglas-fir beetle continued to infest areas heavily defoliated by spruce budworm. Beetle-caused mortality between 1982 and 1987 is summarized in our 1987 report. In the past two years, mortality has increased along the Colorado Front Range and near Blue Mesa Reservoir on the Gunnison National Forest. In some areas, the beetle attacked trees not previously infested with budworm.

Control measures are not feasible in most infested areas due to lack of accessibility and poor cost-effectiveness.

Douglas-fir dwarf mistletoe: *Arceuthobium douglasii* Engelm.

Dwarf mistletoe occurs on Douglas-fir in the southern two-thirds of Colorado (Figure 2). No suppression projects were funded by FPM this last year for this mistletoe species.

PONDEROSA PINE COVER TYPE

INSECTS AND DISEASES THAT AFFECT THE PONDEROSA PINE COVER TYPE

Mountain pine beetle: *Dendroctonus ponderosae* Hopkins

Mountain pine beetle (MPB) populations have generally declined throughout the Region over the past 3 years, but in some areas beetle-caused mortality continued to cause significant losses.

In Colorado, an outbreak on the Uncompaghre Plateau continued and is at epidemic levels. Increased mortality also occurred north of Mancos on both private and National Forest System lands. Managed and unmanaged stands were infested in this area.

In Wyoming, increases in tree mortality occurred on the Douglas Ranger District, Medicine Bow National Forest (refer to section on Cottonwood-Esterbrook project).

In South Dakota, the Black Hills National Forest showed no significant change in beetle populations. Roughly 33 percent of the Black Hills was surveyed by air but the reliability of the survey was weakened by smokey conditions from the Yellowstone fires. Approximately 7,100 trees faded on about 2,500 acres (125,000 cu. ft. mortality) based on the eastern third of the Forest included in the survey.

Cottonwood-Esterbrook Project--The Cottonwood-Esterbrook Integrated Pest Management Project began in Albany and Converse Counties, Wyoming in July 1988. The goal of this project is to manage the resources in the area in a manner that is not conducive to the development or perpetuation of pest problems. The objectives are to:

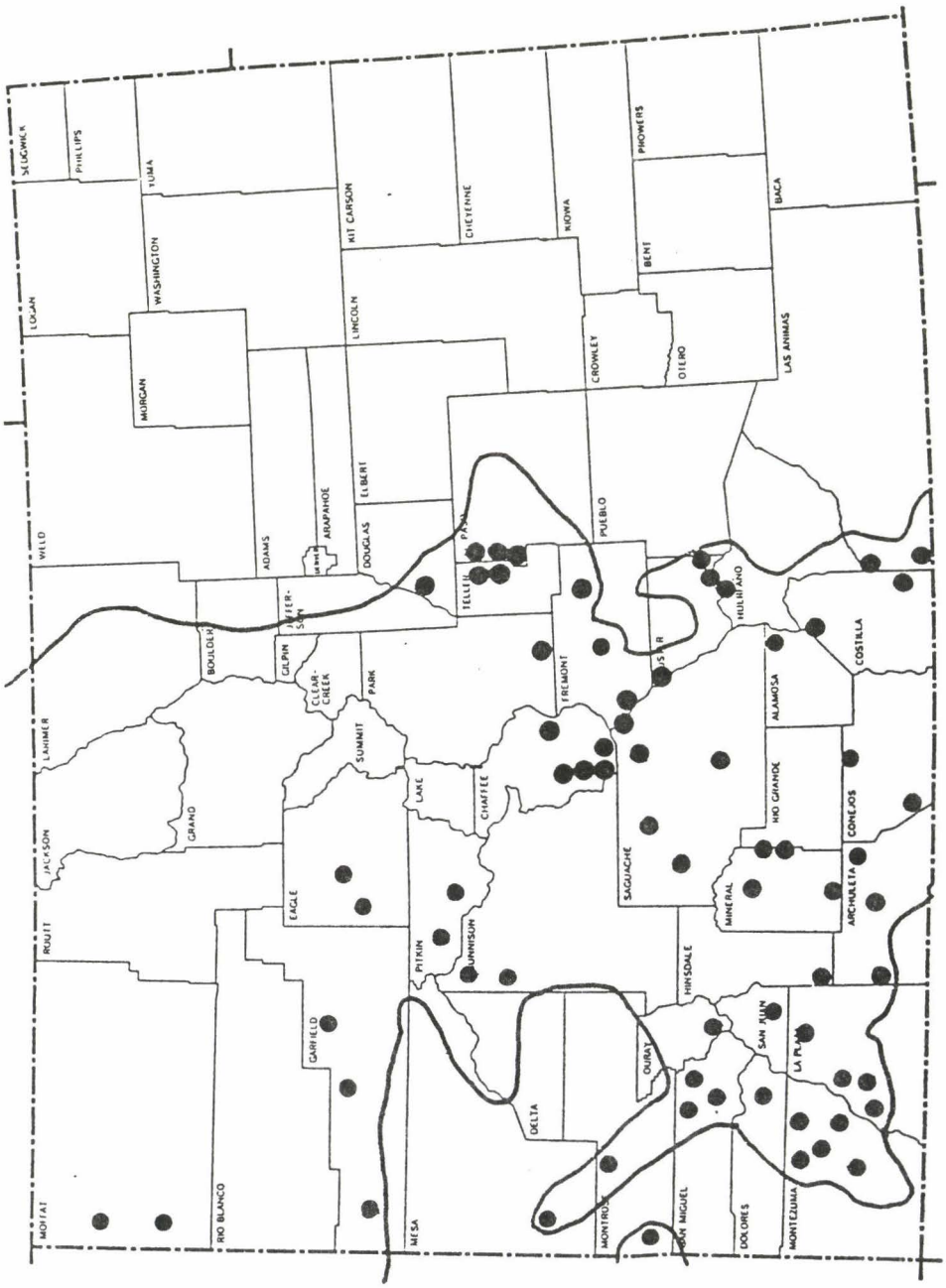

Figure 2. *Arceuthobium douglasii* on Douglas-fir. Area within the solid lines represents distribution of Douglas-fir; circles represent areas where mistletoe was collected or reported.

1. Prevent or suppress epidemic mountain pine beetle populations that are threatening the forested area by establishing insect and disease resistant stands through silvicultural treatments.

2. Reduce wildfire hazard through treatment of debris caused by dead trees and logging debris.

3. Maintain or improve fish and wildlife habitat through forest management practices.

4. Salvage infested and dead ponderosa pines.

5. Establish effective cooperation between County, State and Federal agencies and private landowners.

The Medicine Bow National Forest has prepared two salvage sales of approximately 3 million board feet each to achieve part of the objectives. Private landowners have organized the Laramie Peak Pine Beetle Association. Analysis is currently being done to determine the best management strategy for an area of approximately 173,440 acres involved in the project area. There are approximately 5,650 acres of National Forest land that are currently infested with the MPB. The area encompasses the Medicine Bow National Forest, Bureau of Land Management, State of Wyoming, and private lands.

The beetle population in this area is at or near the peak of an epidemic. MPB risk is high. Beetle mortality caused the overall average basal area and trees/acre to change from 176 BA and 292 trees/acre in 1985 to 65 BA and 129 trees/acre in 1988 in infested pockets. In comparison, uninfested plot averages are currently 127 BA and 225 trees/acre. Nearly all the stands surveyed are in the high risk category of susceptibility to MPB.

Management of mountain pine beetle with semiochemicals--The application of PheroTech "Tree Baits" to two areas of ponderosa pine on the Castle Rock District, Colorado State Forest Service, also appears to have been successful in containing MPB. Bait deployment throughout 9 acres of Castlewood Canyon State Park and 25 acres of Greenland Ranch just east of Larkspur was completed in July 1988 just prior to peak beetle flight. In both areas, baits were deployed at a rate of 9 baits/acre plus a single-bait row around the perimeter.

Examination of both ponderosa pine areas in October and again in late November indicated that the baits did attract beetles originating from infested trees. All baited trees in both areas were heavily attacked, with the exception of those thought to have received defective and/or improperly deployed baits. In most cases, 2-4 trees of susceptible size immediately adjacent to baited trees were also attacked. An examination of surrounding green stands indicates the strategy was successful in containing the beetles and limiting the area requiring salvage work. This work is an excellent example of the "cut, bait and treat" strategy developed in western Canada and the northwestern U.S.

Verbenone, the anti-aggregation semiochemical was field-tested on MPB on the Black Hills National Forest and on the Uncompahgre National Forest to determine its effectiveness in reducing the number of attacks in susceptible ponderosa pine stands. Four treatment rates ranging from 10 to 68 verbenone capsules per acre were tested. None of the treatments were effective at reducing the number of trees attacked by the beetle. The effectiveness of the treatments was reduced by above average temperatures which followed early deployment of the capsules. This may have resulted in depletion of the material or changes in chemistry before the peak beetle emergence period. More testing is planned for 1989.

Pine engraver beetles: *Ips* species

Ips populations increased in the Black Hills in 1987 and remained static to increasing in 1988. Drier than normal weather may have contributed to the Ips increase. Much of the mortality attributed to MPB is shared with this insect, particularly in the southern portion of the Black Hills where Ips predominates.

Management of Ips with semiochemicals--Pheromone traps were deployed for the first time in the Black Hills. The South Dakota State Division of Forestry, with aid from the USFS and PheroTech, Inc., initiated the evaluation on use of semiochemicals to prevent losses to Ips in newly thinned stands. Evaluation objectives were to determine the best mixture of the semiochemicals for the Ips beetle pheromone, dienol, and to determine if trapping Ips in a newly thinned stand could prevent losses.

A preliminary report showed 9,000 beetles were collected over all trial areas. All formulations of the pheromone appeared to attract beetles equally, and no new faders were found in the trapping sites. Faders were found in the control sites without beetle traps. An official report of this study will be available in 1989.

Ponderosa pine dwarf mistletoe: *Arceuthobium vaginatum* (Willd.) Presl. subsp. *cryptopodum* (Engelm.) Gill.

Approximately 20 percent of the ponderosa pine type is infested with this mistletoe in Colorado (Figure 3). Annual losses amount to over 885,000 cubic feet. Pressuppression survey and suppression projects were funded by FPM on 1,479 acres of mixed ponderosa pine and lodgepole pine on the Pike and San Isabel National Forests.

Control of ponderosa pine dwarf mistletoe with ethephon--Tests were begun with the growth regulator ethephon for control of ponderosa pine dwarf mistletoe in the Black Forest, north of Colorado Springs, Colorado in 1988 to determine the relative effectiveness of applications made in mid-June, mid-July and mid-August. Ethephon was applied with a commercial hydraulic sprayer at rates of 2200 and 2700 ppm and a water control. No significant difference in results were obtained from the two application rates of ethephon and shoot abscission rates of 73 to 98 percent were obtained. Similarly, there were no significant differences in results from the applications on the three spray dates. Thus we conclude, that ethephon may be applied to ponderosa pine dwarf mistletoe anytime during the summer prior to seed dispersal to cause shoot abscission and minimize spread of the parasite. Further monitoring is planned to determine the interval between application and seed production by new developing mistletoe shoots.

LODGEPOLE PINE COVER TYPE

INSECTS AND DISEASES THAT AFFECT THE LODGEPOLE PINE COVER TYPE

Mountain pine beetle: *Dendroctonus ponderosae* Hopkins

Mountain pine beetle populations have generally declined in lodgepole pine. Endemic populations continue in the Blue River area on the White River National Forest. The Colorado State Forest Service

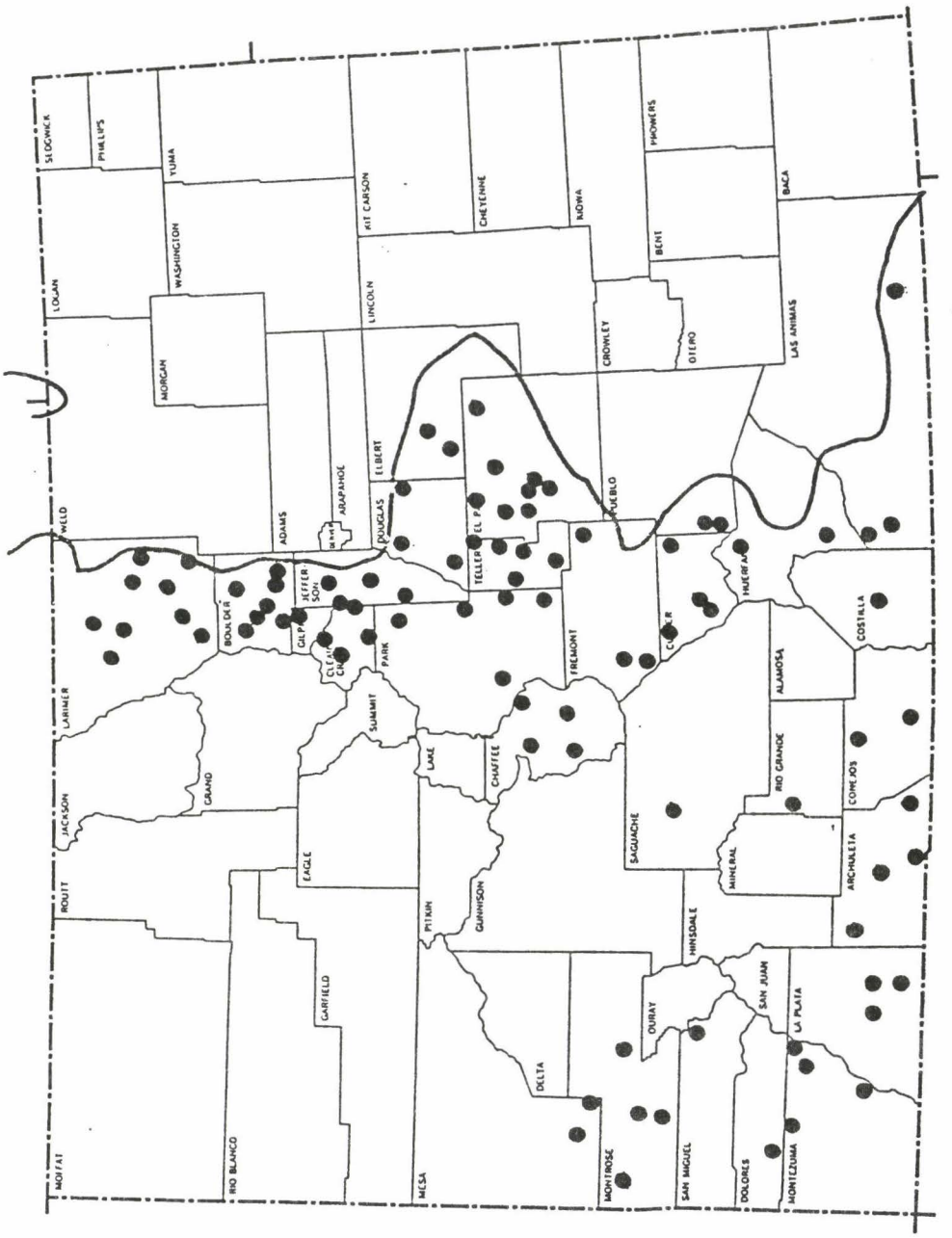

Figure 3. *Arceuthobium vaginatum* subsp. *cryptodum* on ponderosa pine. Area within the solid lines represents distribution of ponderosa pine; circles represent areas where mistletoe was collected or reported.

reported a significant increase in tree mortality occurred on the Summit County side of Ute Pass along Pass Creek.

Beetle-caused mortality remained at low levels on the southern end of the Shoshone National Forest near Lander, Wyoming.

Management of mountain pine beetle with semiochemicals--Operational applications of PheroTech "Tree Baits" to mop-up and contain MPB in lodgepole pine in eight units of the CSFS High Country District (Summit and Grand Counties) appear to have been successful. The expected beetle colonization pattern of attacks centering on baited trees and trees immediately adjacent to baited trees was observed. Planned salvage and harvest operations are in various stages of completion.

Lodgepole pine dwarf mistletoe: *Arceuthobium americanum* Nutt. ex Engelm.

Approximately 50 percent of the lodgepole pine type is infested with dwarf mistletoe in Colorado (Figure 4). Annual losses on National Forest system lands alone in Colorado and Wyoming amounts to over 10 million cubic feet.

Annual plans for survey and suppression of this mistletoe have continued throughout the Region. Presuppression surveys were conducted on 27,432 acres on four National Forests. Cultural control was conducted on 3,714 acres on seven National Forests (Table 1).

Control of lodgepole pine dwarf mistletoe with ethephon--Test plots were re-evaluated in August 1988 for ground applications of 2500 ppm ethephon applied to dwarf mistletoe on lodgepole pine from 1983 through 1985. Bottle sprayers, a back-pack mistblower, and a hydraulic sprayer were used to apply the chemical. Dwarf mistletoe abscission rates of 78 to 100 percent were consistently achieved within 2 to 5 weeks using these three application methods. All infections with complete shoot abscission were observed for development of new mistletoe shoots and /or berries for up to 5 years after treatment. Conclusions of these studies are:

1. Ethephon does not kill dwarf mistletoe, but it does cause significant shoot abscission leading to reduced spread and intensification of the disease.

2. Ethephon must make direct contact with shoots to cause abscission.

3. All ground spray methods were effective; aerial sprays with a helicopter were not effective.

4. Seed and berry production were substantially reduced for up to 4 years after ethephon treatment at 2500 ppm with a surfactant.

5. Ethephon re-application should be considered in the 5th year to eliminate newly developing shoots and berries.

Ethephon shows promise as an effective, safe, and economical way to reduce the spread of dwarf mistletoe in high value stands. It will also provide forest managers with another control option to use in conjunction with other effective silvicultural control methods.

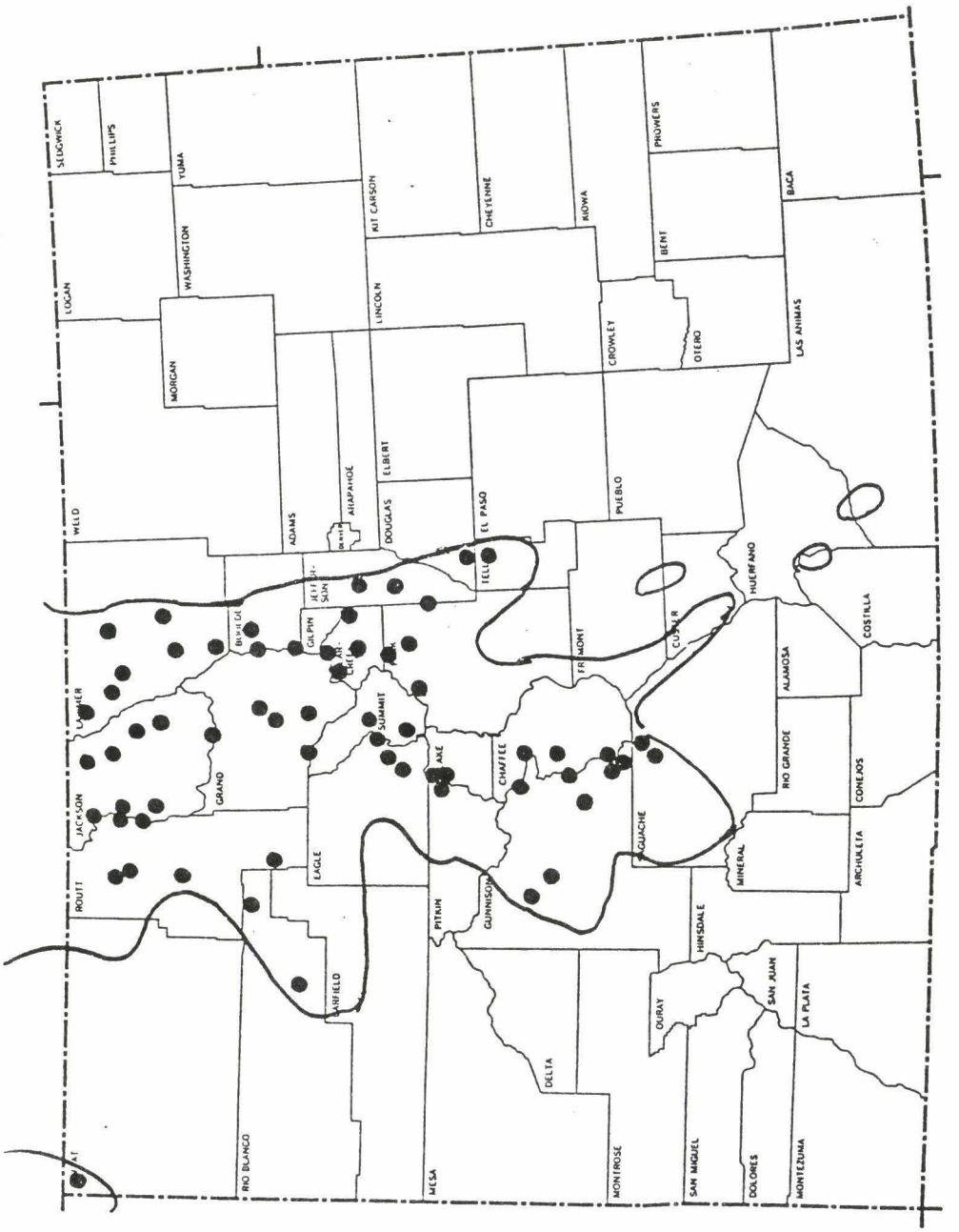

Figure 4. *Arceuthobium americanum* on lodgepole pine. Area within the solid lines represents distribution of lodgepole pine; circles represent areas where mistletoe was collected or reported.

TABLE 1. ACRES OF PRESUPPRESSION SURVEYS AND SUPPRESSION PROJECTS FUNDED BY FPM AND CONDUCTED IN 1988 FOR DWARF MISTLETOE ON FEDERAL LANDS, MOSTLY IN LODGEPOLE PINE TYPE.

National Forest	Presuppression Survey Acres	Suppression Project Acres
Grand Mesa, Uncompahgre & Gunnison	--	360
Medicine Bow	17,507	1,717
Arapaho & Roosevelt	7,812	857
Routt	--	145
Pike & San Isabel	1,439	40
Shoshone	--	140
White River	674	455
TOTALS	27,432	3,714
Bureau of Land Management (USDI)		
Colorado	1,900	177
Wyoming	6,500	53
TOTALS	8,400	230

Vectors of lodgepole pine dwarf mistletoe--Research conducted at the Rocky Mountain Forest and Range Experiment Station in Fort Collins has shown that establishment of *A. americanum* beyond the range of its explosive seed can be explained by vector dissemination of seed. Animals serve as vectors as indicated by seeds found on 14 different species. At least two previous studies have shown that birds can inoculate susceptible trees. Seeds removed during the animals' regular grooming can cause infection, if seeds are viable and deposited in host trees where infections can take place.

The distance seeds can be transported by animals depends upon how large their home range is and whether they are migratory or resident animals. The most important bird and mammal vectors found were resident animals that affect local and short-distance spread of the disease between adjacent infected and healthy stands. Migratory birds, such as robins, warblers, saw-whet owls, and hermit thrushes may be important in long-distance spread of the parasite. .

ASPEN COVER TYPE

INSECTS AND DISEASES OF THE ASPEN COVER TYPE

Aspen regeneration problem survey

The Rocky Mountain Region is enjoying increased interest in aspen utiiization. The aspen harvest has increased to the point that occasional regeneration failures have caused concern. Results of a telephone survey of the National Forests in spring 1988 indicated that on Forests where regeneration failures have been observed, the failure rate was about 6-7 percent of units harvested. Compared to the total acres of aspen cut between 1982 and 1987, the percentage of acres that are not regenerated to aspen averages at most 1 percent. On some Forests, the failure rate is several times this average. In southern Colorado, some unregenerated acres have converted to other vegetation.

Land managers would like to be able to predict whether a given aspen stand might have problems regenerating. A survey conducted in summer 1988 was a first step in discovering indicators of the ability of an aspen stand to regenerate. The objective of the 1988 survey was to collect data from poorly-regenerating aspen cuts and compare them to data collected from similar cuts which were regenerating well. Several Forest Ranger Districts and one Colorado State District Office supplied stand information and maps for this survey.

Summary: Twenty-two aspen cuts in Colorado, Wyoming, and South Dakota, which regenerated either poorly or well, were surveyed in summer 1988.

A number of parameters had statistically different ($P = 0.05$) means between the stands regenerating well and poorly. These parameters included slope, topography, and numbers of live sprouts. Significant parameters for dominant sprouts between poor and good stands included height, age, stem disease, other stem damage, and root condition (Table 2).

In looking at the various stands throughout the Region, it is apparent that different sets of problems in the regeneration of aspen occur in different areas. For example, snow damage, dry sites, wet sites, and herbivore pressure may be variously involved.

Table 2. MEANS FOR PARAMETERS WITH STATISTICALLY SIGNIFICANT DIFFERENCES DETERMINED BY THE CHI-SQUARED TEST WITH P = 0.05, FOR DOMINANT SPROUTS IN ASPEN CUTS REGENERATING WELL (GOOD) AND POORLY (POOR), SURVEYED IN SUMMER 1988.

Parameter	Poor	Good
Height	0.9 m	1.6 m
Age	3.7 yrs	4.6 yrs
With Cytospora	10.5 %	2.5 %
With Undamaged Stems	23.4 %	50.1 %
With Browsing Damage	43.8 %	12.2 %
With Healthy Roots	78.9 %	92.8 %
With Dead Roots	18.7 %	6.4 %
With Healthy Root Xylem	78.9 %	91.7 %
Without Root Rot	95.3 %	99.3 %

In 1989, more stands in Forests that either have a relatively large aspen harvest and/or problems with the sudden sprout dieback will be surveyed, especially the Grand Mesa and San Juan National Forests. Additional work in determining the etiology of this sudden sprout mortality will be continued with the cooperation of Colorado State University and the Rocky Mountain Forest and Range Experiment Station.

URBAN AND SHELTERBELT TREE PROBLEMS

Gypsy moth: *Lymantria dispar* (Linnaeus)

The gypsy moth has become a more serious threat in the Region in the past three years. Vegetation on both forested and unforested lands of all ownerships may be affected if moth populations become well established.

State and private lands: The Colorado State Forest Service reports a total of 3,601 pheromone traps and 25 live female traps were outplaced to detect, delimit and mass-trap male moths. Eradication treatments were initiated in Boulder and Fort Collins.

The west infestation in Fort Collins was successfully ground sprayed with three applications of *Bacillus thuringenisis* (Bt). The eastern infestation was treated with the F1 sterile insect technique. Boulder's infestation was successfully treated by helicopter with three applications of Bt. The Wheatridge/Lakewood detection area from 1987 was mass trapped. No new moths were found after trapping Colorado Springs at delimitation densities.

Plans for 1989 will include the following: monitor with detection density traps (Boulder); mass trap the 1988 spray area (Boulder); deploy delimitation density traps (Boulder); mass trap areas further defined in 1988 (Denver); spray recommendations (Denver, east area Ft. Collins); repeat F1 sterile insect techniques with modifications to protect larvae from avian predation (east area of Ft. Collins); mass trap in conjunction with limited individual tree spraying.

A full consideration of the options will occur prior to actual selection of methods employed in 1989.

National Forest System lands: For years we have known that most isolated infestations of the gypsy moth are started from egg masses transported from infested areas on outdoor household articles, campers, vehicles and any other items that provide accessible, protected sites for the female at egg laying time.

Since the recreation areas of our Region attract visitors from across the country, our detection efforts have focused on these areas as potential sites for infestations. Forest Pest Management has been coordinating detection trapping on NFS lands since 1982. From 1982-1987, trapping sites were randomly selected from all recreation sites with suitable gypsy moth habitat. Recently this approach was refined and efforts were concentrated where isolated infestations were most likely to begin. In 1988, five criteria were used to select trapping sites and a more structured detection program was initiated. A list of sites meeting the following criteria was prepared with the help of the Timber and Recreation staffs of the 12 National Forests in the Region:

- ☐ Recreation sites in or adjacent to stands having a hardwood component or containing woody shrubs

and

  a. Support greater than 5,000 recreation visitor days (RVD's) of general, auto and trailer camping per year. Examples are sites along travel corridors to Yellowstone National Park, Mount Rushmore National Monument, Rocky Mountain National Park, Colorado National Monument, Meas Verde National Park, etc.

or

b. Are likely to be visited in the spring by people from the generally infested areas. Examples are sites on NFS lands adjacent to fishing areas, lodges, religious retreats, summer camps, etc.

or

c. Are near year-round resorts. Examples are campgrounds and picnic areas near Aspen, Vail, and Keystone ski areas.

or

d. Are near residential areas with mobile or seasonal populations. Examples are sites near summer home groups on NFS lands and residential areas with resorts.

Results of trapping on NFS lands--In 1988, our detection efforts resulted in the first capture of a gypsy moth on NFS lands in Region 2. One moth was caught in a trap placed at the Eagle Creek Campground on the Wapiti District, Shoshone NF. Traps had been placed at this site each year since 1986. Two traps were placed in this campground in 1988.

Eagle Creek Campground is located along Highway 20 which is the main route from Cody to the east entrance of Yellowstone Park. The site is approximately 8 miles from the Park entrance.

Botryosphaeria canker: *Botryosphaeria* spp.

This disease, identified on juniper in Kansas for the first time last year, is associated with branch dieback and mortality of Rocky Mountain juniper in windbreaks and ornamental plantings. It is also found in eastern redcedar windbreaks, although this species does not appear to be as susceptible. Reports of the disease have continued and many samples were forwarded to the Kansas State University diagnostic center for identification.

In Nebraska, damage has been found throughout the eastern two-thirds of the state.

Cedar-apple rust: *Gymnosporangium juniperi-virginiae* Schw.

Rust on cedars and junipers in south and central areas of South Dakota was the heaviest recorded. Entire rows in shelterbelts were so heavily infested that branches broke from the weight of galls. Branch dieback is expected on some trees due to the number of galls.

Dutch elm disease: *Ceratocystis ulmi* (Buism.) C.Mor.

Dutch elm disease continues to be a major program emphasis area of the Colorado State Forest Service and a catalyst for urban and community forestry programs. Eighty-three cities and towns are involved in programs, primarily concentrated in the eastern third of the state. Positive cases of the disease from CSFS lab analysis showed a decrease in the disease from 741 cases in 1987 to 523 in 1988.

Incidence of the disease in Kansas has increased the past two years. Explanations for the increase include two mild winters and a relaxation of sanitation efforts.

The disease continues to spread in South Dakota into woody draws in the western part of the state. As the elm population declines, the epidemic is expected to subside.

Phomopsis canker of Russian olive: *Phomopsis arnoldiae* Sutton

The general decline and dieback of Russian olive caused by this fungus is becoming a serious problem in windbreaks in eastern Kansas. Since no chemical controls are available, other tree species may need to be planted.

Pinewood nematode: *Bursaphelenchus xylophilus* (Steiner et Buhrer) Nickle

Pinewood nematode was confirmed again in Johnson County, Kansas from several Scots pine samples. This was in the same area as reported last year. Although the incidence of the disease in the state is quite low, there is concern about the potential damage to pine windbreaks. Sanitation is recommended as the control measure.

Pine tip blight: *Sphaeropsis sapinea* (Fr.) Dyko & Sutton

Pine tip blight continues to be a problem throughout most of Kansas. Proper timing of fungicides can control the disease, but applications must be made several years in a row for good control. The disease also appeared in the Black Hills, however, it is not as extensive or severe as the outbreak that occurred there in 1980-81.

Thyronectria canker: *Thyronectria austro-americana* (Speg.) Seeler .

This canker continues to cause damage and mortality in Colorado to urban plantings of honeylocust at approximately one percent of the honeylocust a year.

The canker also continues to be a problem on honeylocust in Kansas windbreaks.

Unknown oak disease

An unusual pattern of oak decline was observed this year in Kansas. Several large bur oak lost most of their leaves after turning brown. Many of the second set of leaves also turned brown and dropped. Herbicides are not suspected as the cause of damage.

ABIOTIC DISEASES

Drought

The summer of 1988 was very dry and temperatures abnormally high in South Dakota. This was the second year of dry conditions in the same areas of the state. Diebacks and declines are expected to continue as a result over the next few years.

Animal damage

In August 1988, the Badlands National Park reported an apparent twig dieback of Rocky Mountain juniper growing in wooded draws. Examination of samples revealed girdling by rodent feeding. Evidently the drought resulted in a lack of usual forage causing mice, voles and other small rodents to feed in these areas.

NURSERY STUDIES

Evaluation of mycorrhizal development of 2-0 conifer stock at Bessey Nursery, Nebraska at lifting in Fall 1987, Spring 1988 and Fall 1988 revealed that mycorrhizal development is generally low. The average percentage of mycorrhizal small roots per seedling was 7 to 12 percent. The range in percentage of mycorrhizal small roots per seedling was 5 to 50 percent.

In Fall 1988, one bed of 2-0 lodgepole pine surrounded by other conifer species exhibited exceptional height and caliper. Mushrooms of *Suillus* sp. and *Thelephora terrestris* were fruiting in this bed. Of 30 seedlings sampled near *Suillus* mushrooms, an average of 33 percent of the small roots of each seedling were mycorrhizal, with a range of 10 to 70 percent. Of 30 seedlings sampled near *Thelephora* mushrooms, an average of 36 percent of each seedling's roots were mycorrhizal, with a range of 7 to 70 percent.

ROCKY MOUNTAIN REGION--SUMMARY OF INSECTS IN COLORADO, KANSAS, NEBRASKA, SOUTH DAKOTA, AND CENTRAL AND EASTERN WYOMING

INSECT	HOST	LOCATION	REMARKS
Bagworms Thyridopteryx ephemeraeformis	Rocky Mountain juniper	Kansas	Populations smaller than normal. Very little damage reported except in areas where no control measures were implemented in 1988.
Cankerworms Alsophila pometaria Paleacrita vernata	Elm, Hackberry, Honeylocust	Kansas, South Dakota	Damage was very low this year. This was quite a change from last year's very large population and severe damage. Damage may have been less than any reported in the last ten years.
Conifer sawfly Neodiprion prob. fulviceps complex	Ponderosa pine	South Dakota	Populations scattered throughout the west central portion of the state. A large outbreak occurred on the Rosebud Indian Reservation.
Dioryctria moths Dioryctria ponderosae D. tumicolella	Ponderosa pine, Scot's pine	Nebraska, Colorado, South Dakota	Continue to be a serious problem of pines in central and western Nebraska. Light damage reported in Colorado. Populations remain high state-wide in South Dakota.
Douglas-fir beetle Dendroctonus pseudotsugae	Douglas-fir	Colorado, Wyoming	Continues to infest areas that were heavily defoliated in the recent past. In some areas the beetle is attacking trees which were not defoliated.
Douglas-fir tussock moth Orgyia pseudotsugata	Douglas-fir, Engelmann spruce	Colorado	Detection surveys trapped moths in the South Platte drainage. Numbers caught did not indicate potential outbreak conditions New infestations occurred on a few trees in Ft. Collins and Vail.
Elm leaf beetle Pyrrhalta luteola	Siberian elm, American elm	Kansas, Nebraska, South Dakota	Severe damage in the western part of Kansas but normal in the east. The second generation caused the heaviest foliar damage. Extensive defoliation throughout Nebraska and South Dakota.
European pine sawfly Neodiprion sertifer	Pine	Kansas	Appears to be moving west, but damage reports are still few in number.
Forest tent caterpillar Malacosoma disstria	Hardwoods	South Dakota	An outbreak caused 50-75% defoliation to most of the hardwoods over several thousand acres in the northeast corner of the state. Viruses were found in large numbers of killed caterpillars and pupal parasites were found. The outbreak is expected to collapse in 1989.
Gypsy moth Lymantria dispar	Hardwoods	Colorado, Wyoming, South Dakota	Detection surveys were conducted throughout the 5-state Region. In Colorado, 149 male moths were trapped in Ft. Collins, 2 male moths in Boulder, and 43 male moths in Lakewood. One moth was caught on the Shoshone NF, just east of Yellowstone NP.

Honeysuckle aphid *Hyadaphis tataricae*	Honeysuckle	South Dakota	The damage can now be found throughout the state; however, some observations indicate that new aphid damage this year seemed less than previous years.
Jack pine budworm *Choristoneura pinus*	Jack pine	Nebraska	No visible defoliation in a previously heavy defoliated stand in the Bessey District on the Nebraska National Forest.
Juniper sawfly *Monoctenus fulvus*	Juniper	Kansas	Populations very low. Very few reports received.
Large aspen tortrix *Choristoneura conflictana*	Aspen	Colorado	Populations have subsided to endemic levels.
Lilac borer *Podosesia syringae*	Green ash, Lilac	Nebraska, South Dakota	Continues to be a problem in young ash trees and lilac.
Mountain pine beetle *Dendroctonus ponderosae*	Limber pine, Lodgepole pine, Ponderosa pine	Colorado, South Dakota, Wyoming	Scattered and static in the Black Hills, approximately 7100 trees faded on about 2500 acres (125M cu. ft. mortality). Populations in Wyoming are increasing in the Laramie Peaks area of the Medicine Bow National Forest. A total of 23,000 trees detected on 12,500 acres in Wyoming (300M cu.ft. mortality). The outbreak on the Uncompahgre Plateau in Colorado continues in ponderosa pine. Elsewhere in Colorado, in lodgepole pine, MPB continues to decrease except in the Blue River area where it is static at low population levels.
Pine engraver beetles *Ips* spp.	Ponderosa pine, Jack pine	Nebraska, South Dakota	Found near thinning operations and in highly stressed trees.
Pine needle sheathminer *Zelleria haimbachi*	Ponderosa pine	Nebraska	Infestations heavy at Hastings, NE and moderate at Horning State Farm near Plattsmouth, NE.
Pine tip moths *Rhyacionia bushnelli* *Rhyacionia frustrana*	Austrian pine, Ponderosa pine, Scots pine, Pinyon pine	Colorado, Nebraska, Kansas	In Kansas, damage was very light compared to previous years. A few Christmas tree growers reported some damage but no windbreak damage was reported. Continues to be a problem on young pine throughout Nebraska. Ornamental pinyon pine in the metro areas of Colorado continue to to be damaged.
Pine budworm *Choristoneura lambertiana*	Ponderosa pine, limber pine	Colorado	Defoliation levels declined in southwestern Colorado.

Spider mites *Oligonychus ununquis*	Juniper	Kansas	Damage reported in May which is earlier than normal. Hot, dry conditions probably contributed to the increase in population.
Spruce beetle *Dendroctonus rufipennis*	Engelmann spruce	Colorado, Wyoming	Populations are at endemic levels in scattered windthrown spruce and logging slash.
Terminal weevils *Pissodes terminalis* *P. engelmanni*	Lodgepole pine, Engelmann spruce, Blue spruce	Wyoming	Light scattered damage continues in lodgepole pine regeneration near Buffalo, WY. Some terminal damage is occurring in ornamental and native spruce near Evergreen, CO.
Walnut caterpillar *Datana integerrima*	Walnut	Kansas	Damage was minor. Individual trees were defoliated. Damage was reported about one month later than normal.
Western balsam bark beetle *Dryocetes confusus*	Subalpine fir	Colorado	Small, widely scattered groups of dying trees were observed. Slight increases are occurring associated with armillaria root disease centers.
Western spruce budworm *Choristoneura occidentalis*	Douglas-fir, Engelmann spruce, Subalpine fir, White fir	Colorado, Wyoming	Overall, populations continue to decline in the chronic infestation areas in Colorado and Wyoming. It is estimated 427,000 acres were lightly defoliated in Colorado and 13,500 in Wyoming. A new area of infestation was discovered in SE Colorado in the Dolores and San Miguel River drainages and covers 15,000 acres.

ROCKY MOUNTAIN REGION--STATUS OF DISEASES IN COLORADO, KANSAS, NEBRASKA, SOUTH DAKOTA, AND CENTRAL AND EASTERN WYOMING

DISEASE	HOST	LOCATION	REMARKS
STEM AND BRANCH DISEASES			
Comandra blister rust *Cronartium comandrae*	Lodgepole pine	Wyoming, Colorado	Continues as the most serious disease of lodgepole pine on the Wind River Ranger District, Shoshone National Forest, where more than half of the mature trees are infested and 85 percent of infected trees have dead tops. Present but not a management problem in northern Colorado.
Dwarf mistletoes *Arceuthobium americanum*	Lodgepole pine	Colorado, Wyoming	Remains the most important disease on federal lands in the Region. Found on about 518,000 acres in Colorado and 361,000 acres in Wyoming, it causes mortality and growth loss equal to approximately 10 million cubic feet. FPM funded presuppression surveys on 27,432 acres on four National Forests and silvicultural control on 3,714 acres on seven National Forests.
Arceuthobium douglasii	Douglas-fir	Colorado	Reports of many trees killed in recreational areas and homesites in the mountains west of Colorado Springs.
Arceuthobium vaginatum subsp. *cryptopodum*	Ponderosa pine	Colorado	Approximately 20 percent of the host type is infested. Annual losses amount to over 885,000 cubic feet.
CANKERS			
Thyronectria austro-americana	Honeylocust	Colorado, Kansas	A major disease problem in urban plantings along the Colorado Front Range. Continues to be a problem in Kansas windbreaks.
Botryodiplodia spp.	Juniper	Kansas	Continues to be a problem in windbreaks.
Phomopsis or *Tubercularia* sp.	Russian olive	Kansas, South Dakota	Continues to cause serious decline and mortality in windbreaks in eastern Kansas.
Botryodiplodia hypodermia	Siberian elm	Colorado, South Dakota	Cankers associated with flagging and decline in eastern Colorado. Elm decline continues throughout South Dakota. Herbicide damage is suspected as a predisposing factor to infection by this fungus.
Botryosphaeria stevensii	Eastern redcedar, Rocky Mountain juniper	Nebraska, Kansas	A serious problem in scattered areas of eastern and central Nebraska and Kansas. Disease incidence in 14 windbreak plantings of Rocky Mountain juniper in Kansas ranged from 2 to 22 percent.
Cytospora spp.	Colorado blue spruce	Colorado	Common on samples from El Paso County.

ROOT DISEASES *Armillaria* spp.	Subalpine fir, Engelmann spruce, Lodgepole pine	Colorado	Most common root disease in the State. The potential for damaging losses is unknown at this time.
FOLIAGE DISEASES *Gnomonia leptostyla*	Walnut	Kansas	Not a problem this year due to dry weather.
Apiognomonia venata (=*Gnomonia platani*)	Sycamore	Kansas	Continues to be very severe in many areas of northeastern Kansas.
Ciborinia whetzelli *Marssonina populi*	Aspen	Colorado, South Dakota	Found throughout the aspen type, these diseases create great aesthetic concern. Fewer reports this year than last year.
Diplodia blight *Sphaeropsis sapinea* (=*Diplodia pinea*)	Ponderosa pine, Austrian pine	Kansas, Nebraska, South Dakota	Branch dieback and tree mortality common in windbreaks and urban plantings. Becoming active again in the Black Hills.
Gymnosporangium juniperi-virginiae	Eastern redcedar	South Dakota	Galls on cedar were extremely heavy, especially in south and central areas of the state. Galls were so numerous on some trees that branches broke.
Puccinia sparganioides	Green ash	South Dakota	Reports more numerous than normal, but less than during the outbreak of 1987. Most trees are expected to recover.
Scirrhia acicola	Scots pine	Kansas	Very few reports from Christmas tree growers this year compared to last year.
Needlecasts *Lophodermella concolor* *Lophodermella montivaga*	Lodgepole pine	Colorado	Was noticeable on trees throughout the Sulphur Ranger District, Arapaho National Forest.
Phomopsis juniperovora *Cercospora sequoiae* *Kabatina juniperi*	Eastern redcedar, Rocky Mountain, juniper	South Dakota, Nebraska	Continues to be a problem in windbreaks.
Dothistroma pini	Austrian pine	Nebraska	A problem on young trees in scattered areas.
WILTS AND DECLINES Dutch elm disease *Ceratocystis ulmi*	Elm species	Colorado, Nebraska, South Dakota	Statewide decline in incidence in Colorado; however, remains top priority for control in Colorado's urban forests. In South Dakota, the disease continues to kill 6 to 10 percent of the American elms in communities without management programs.

Pinewood nematode *Bursaphelenchus xylophilus*	Scots pine	Kansas	Reported for the second year in Johnson County. Sanitation recommended as the control measure.
Undetermined	Juniper	Kansas	Continual problem in windbreaks. Symptoms usually include tip dieback, branch mortality, or complete death of trees. Causal agent still undetermined.
Undetermined	Green ash	Colorado	A few cases of declining ash noted in urban areas. No evidence of mycoplasmas, that cause decline in states to the east and west of Colorado.
NURSERY PROBLEMS			
Cylindrosporium sp.	Black cherry	Nebraska	Leaf shothole disease controlled with Dodine.
OTHER			
Chemical damage	Many tree species	Colorado	Improper use of herbicides and soil sterilants continues to damage and kill trees in the Front Range and eastern Colorado.
Unknown decline	Ponderosa pine	Colorado	A general recovery of pine from the mid-'80's noted in the San Juan Basin in southwestern CO.
Sprout dieback	Aspen	Colorado	Mortality of few to several-year-old sprouts occurs infrequently after harvest of aspen stands. Preliminary observations indicate some association with wet sites, dry sites, snow breakage and herbivore damage.
Rodent feeding	Rocky Mountain juniper	South Dakota	Rodents girdled small branches and twigs in woody draws in Badlands National Park. Scarce moisture and high temperatures caused a lack of grasses and other forage normally utilized by rodents.
Hail damage	Engelmann spruce, Subalpine fir, Lodgepole pine	Colorado	30-50 acres of natural seedlings and saplings had branch wounds.
Heat scorch	*Amelanchier paraphyllum*, many other species	Colorado	Leaf edges turned brown and shriveled in the presence of drying wind and high temperature in Mesa Verde National Park. Scorch symptoms also reported in urban plantings.

Drought, winter injury, other unknown agents	Ponderosa pine, Black walnut, Buffaloberry, Blue spruce, Russian-olive, Dogwood, Pear	South Dakota	Drought and abnormally high temperatures affected trees in many counties throughout the state.
High water	Ponderosa pine	Colorado	Pockets of mortality noted north of Mancos, CO.
Frost	Colorado blue spruce	Colorado	Late season frost damage reported in eastern counties.

USE OF HERBICIDES IN REGION 2 FOR 1984-1988 (MAJOR HERBICIDE USES ONLY)1/

HERBICIDE	APPLICATION METHOD	1984	1985	1986	1987	1988
		Acres Treated				
2,4-D	Ground	1,971	2,243	2,857	2,592	4,623
Picloram (Tordon)	Ground	2,782	2,452	3,167	2,769	3,945
Glyphosate (Roundup)	Ground	235	102	244	387	100
Dicamba (Banvel)	Ground	339	292	295	600	469

1/ Major target species are big sagebrush, sand sagebrush, Canada thistle, leafy spurge, *Wyethia* spp. and various broadleaf weeds for range improvement and roadside management projects.

PESTICIDE USE IN REGION 2 IN FY 88 1/

Type of Pesticide	Chemical Used	Target Pest	Units Treated 2/
Fumigant	Methyl bromide/ chloropicrin	Nematodes and Fusarium in nursery beds	13
Fungicide	Benomyl	Phomopsis canker in eastern redcedar nursery stock	41
	Bordeaux mixture	Diplodia tip blight in nursery stock	1
	Dodine	Shothole disease in nursery stock	3
Herbicide	Chlorsulfuron	Noxious weeds	38
	Dacthal	Nursery weed control	19
	Dicamba	Noxious weeds	469
	Diuron	General weed control	3
	Glyphosate	General weed control	8
	Glyphosate	Noxious weed control	67
	Glyphosate	Nursery weed control	25
	Hexazinone	Wildlife habitat improvement	1
	Picloram	Noxious weed control	2,161
	Picloram	Poisonous plant control	12,500 sq.ft.
	Tebuthiuron	Range vegetation improvement	40
	2, 4-D	Noxious weed control	3,387
	2, 4-D	Poisonous plant control	244
	2, 4-D	Range management improvement	103
Herbicide	2, 4-D	Wildlife habitat improvement	68
	2, 4-D/Picloram	Noxious weed control	943
Insecticide	*Bacillus thuringiensis*	Mosquitos	1

Type of Pesticide	Chemical Used	Target Pest	Units Treated 2/
	Carbaryl	Cottonwoood leaf beetle	4
	Carbaryl	Mountain pine beetle	150 trees
	Coumaphos	Lice, mites, ticks	14,000 head of cattle
	Dimethoate	Tip moths	17
	Malathion	Grasshoppers	4,320
Rodenticide	Aluminum phosphide	Prairie dogs	200 burrows
	Aluminum phosphide	Prairie dogs	169
	Zinc phosphide	Prairie dogs	6,013
Piscicide	Antimycin	Undesirable fish	1 stream mile

1/ Includes use by the USDA Forest Service, other federal agencies, permittees, licensees, and grantees.

2/ Units are in acres unless otherwise indicated.

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